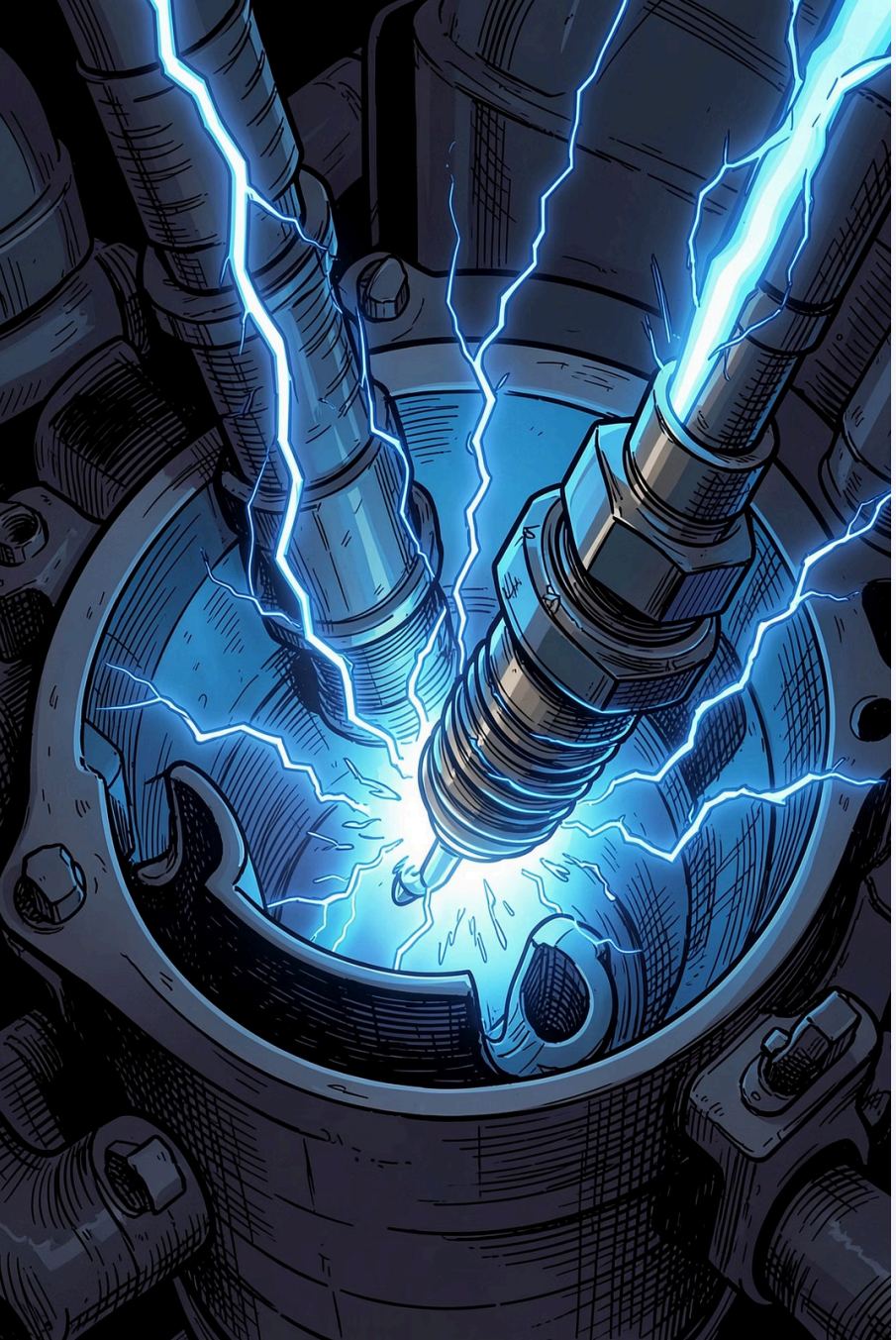
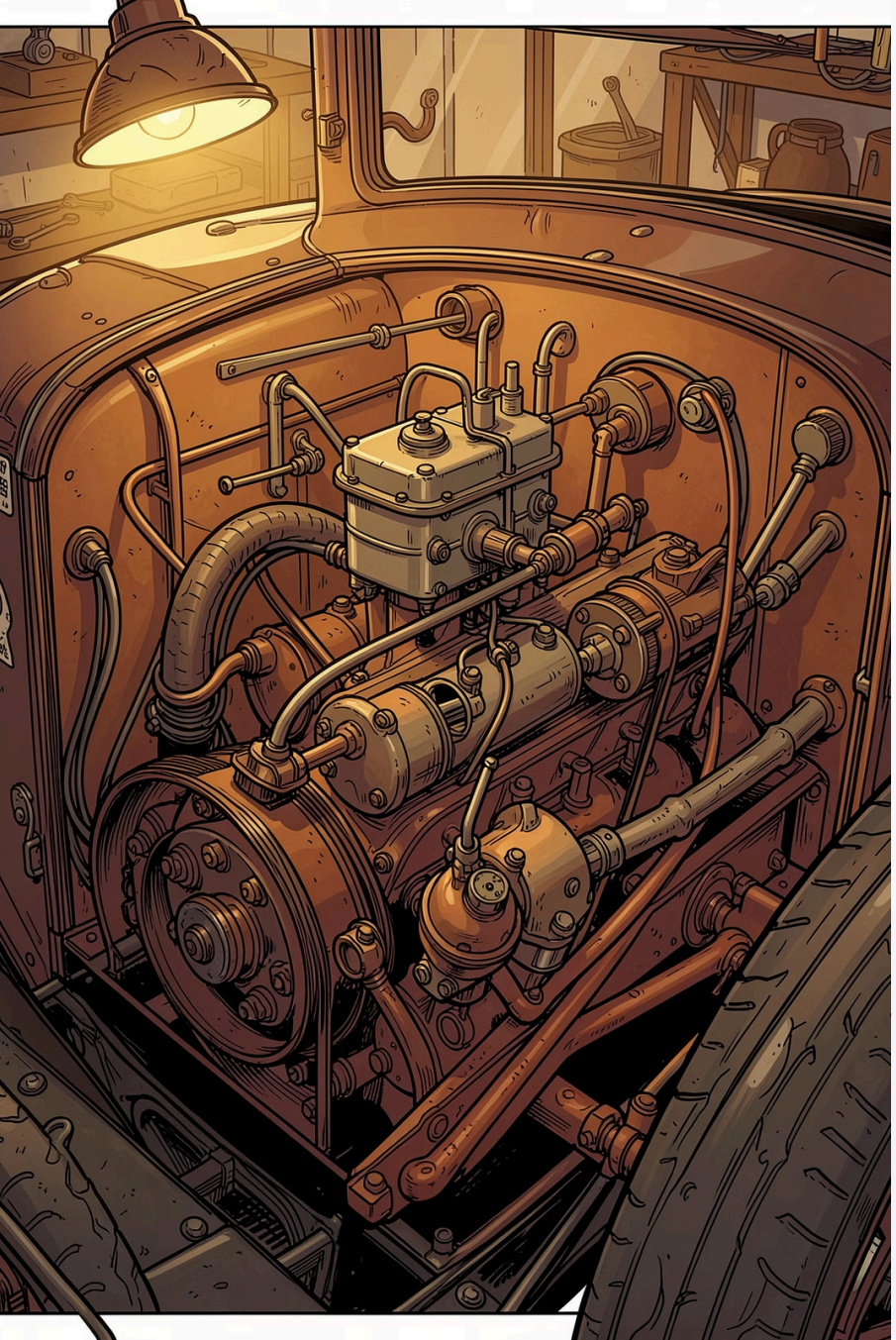


## Ignition Repair

# From Mechanical Sparks to Digital Precision

A journey through over a century of ignition technology — from the first contact breakers to today's digitally controlled direct ignition systems.

Made with GAMMA



CHAPTER 1

# The Mechanical Era: 1907

## Charles Kettering's Breakthrough

Kettering introduced the first practical point ignition system, replacing unreliable magneto setups with a battery-powered, timed spark.

## Contact Breakers & Capacitors

Mechanical contact breakers opened and closed in sync with engine rotation, while capacitors suppressed arcing and sharpened the spark.

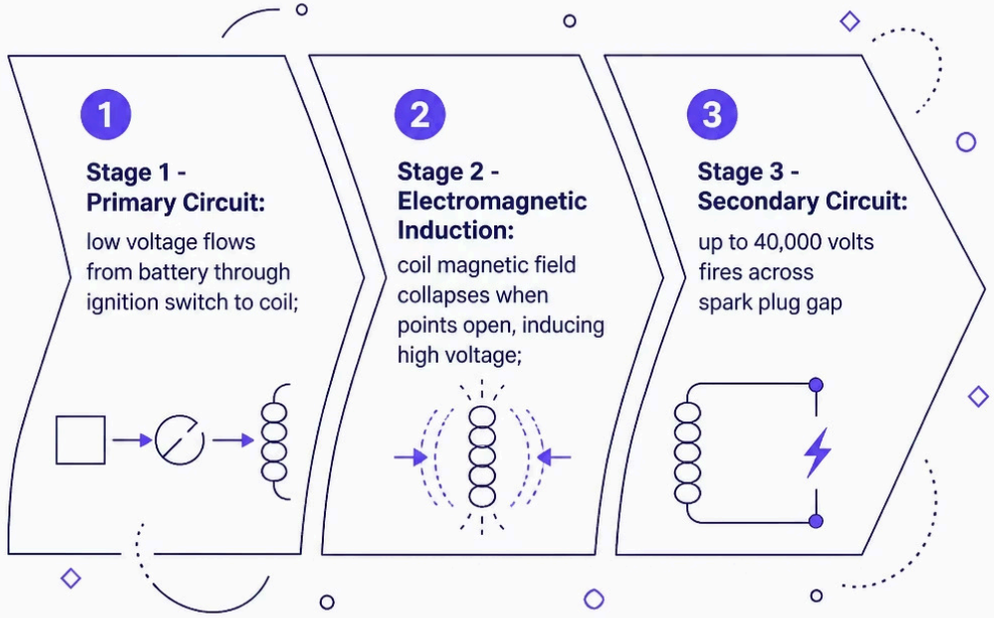
## The Distributor

The distributor routed high-voltage pulses to each spark plug in the correct firing order — the cornerstone of ignition timing for decades.

Made with GAMMA

CHAPTER 2

# Anatomy of the Spark


1
Stage 1 - Primary Circuit:
low voltage flows from battery through ignition switch to coil;
2
Stage 2 - Electromagnetic Induction:
coil magnetic field collapses when points open, inducing high voltage;
3
Stage 3 - Secondary Circuit:
up to 40,000 volts fires across spark plug gap

## How the Spark is Born

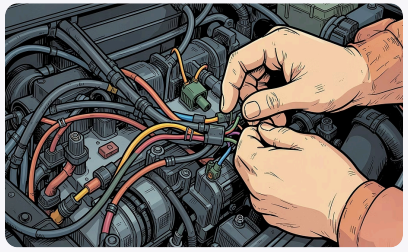
The ignition system operates across two circuits. The **primary circuit** carries low voltage from the battery through the ignition coil. When the contact points open, the magnetic field collapses — inducing a massive voltage surge in the **secondary circuit**.

That surge, reaching up to **40,000 volts**, jumps the spark plug gap and ignites the air-fuel mixture.

Made with GAMMA

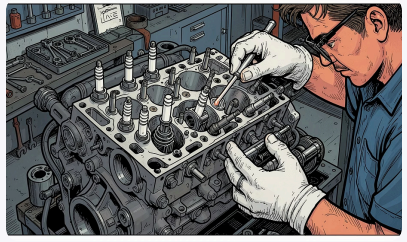
CHAPTER 3

# Identifying the Failure



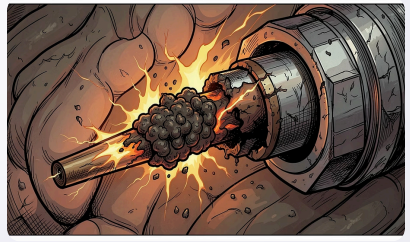
## Preliminary Inspection

Check for loose connections, cracked distributor caps, and damaged wiring before deeper diagnosis.



## Dead Cylinder Check

Perform a manual cylinder balance test to isolate the misfiring cylinder by monitoring RPM drop.



## Visual Warning Signs

Arcing marks, burnt electrodes, or heavy carbon deposits signal wear, incorrect timing, or fuel mixture issues.

Made with GAMMA

CHAPTER 4

# The Spark Test: Assessing Quality

### Install the Tester

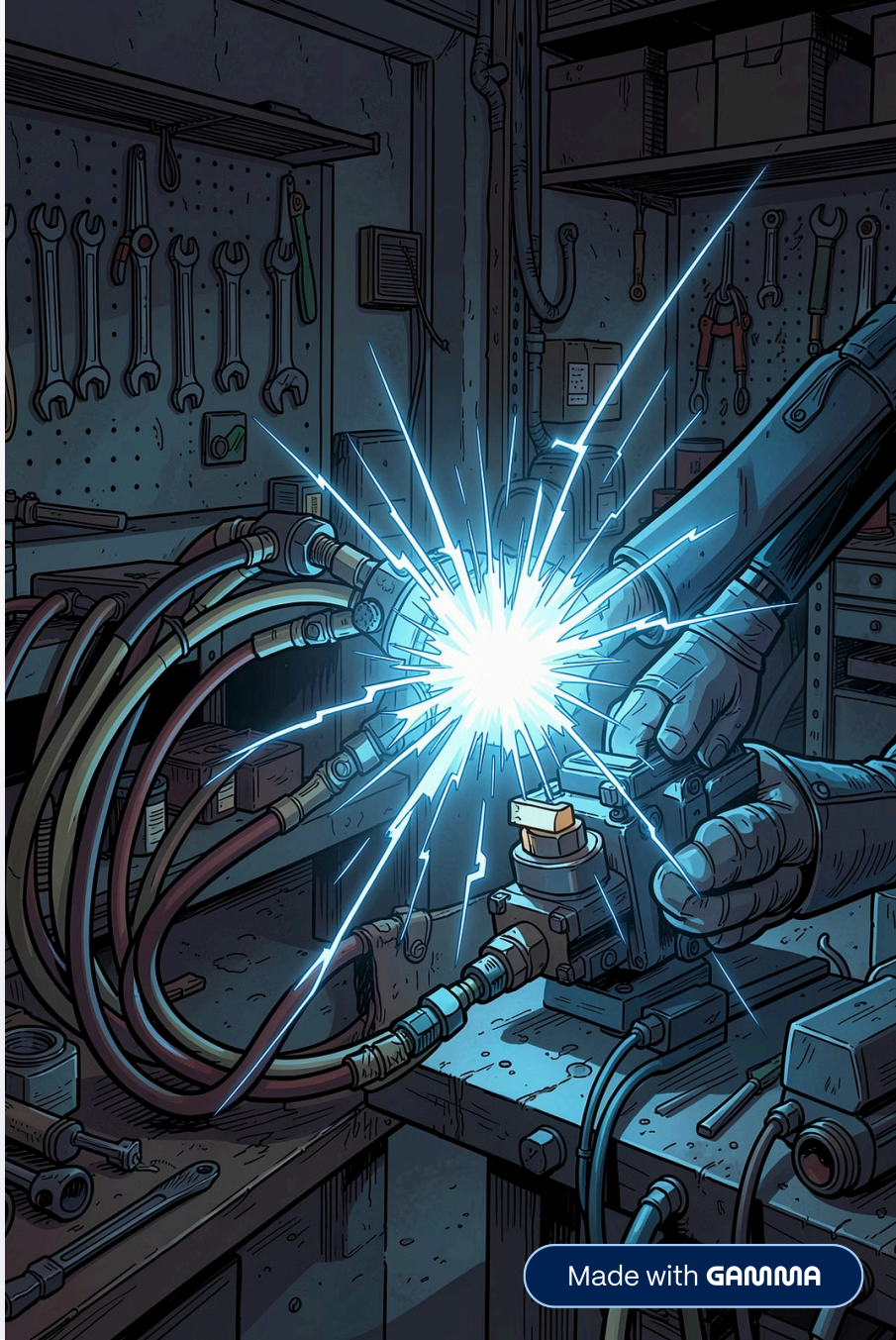
Connect a spark tester in line with the plug wire to safely observe arc intensity without risking shock.

### Healthy Spark Criteria

A strong system produces a **wide, bright blue, snapping arc** — a clear sign of adequate voltage and timing.

### Diagnose the Scope

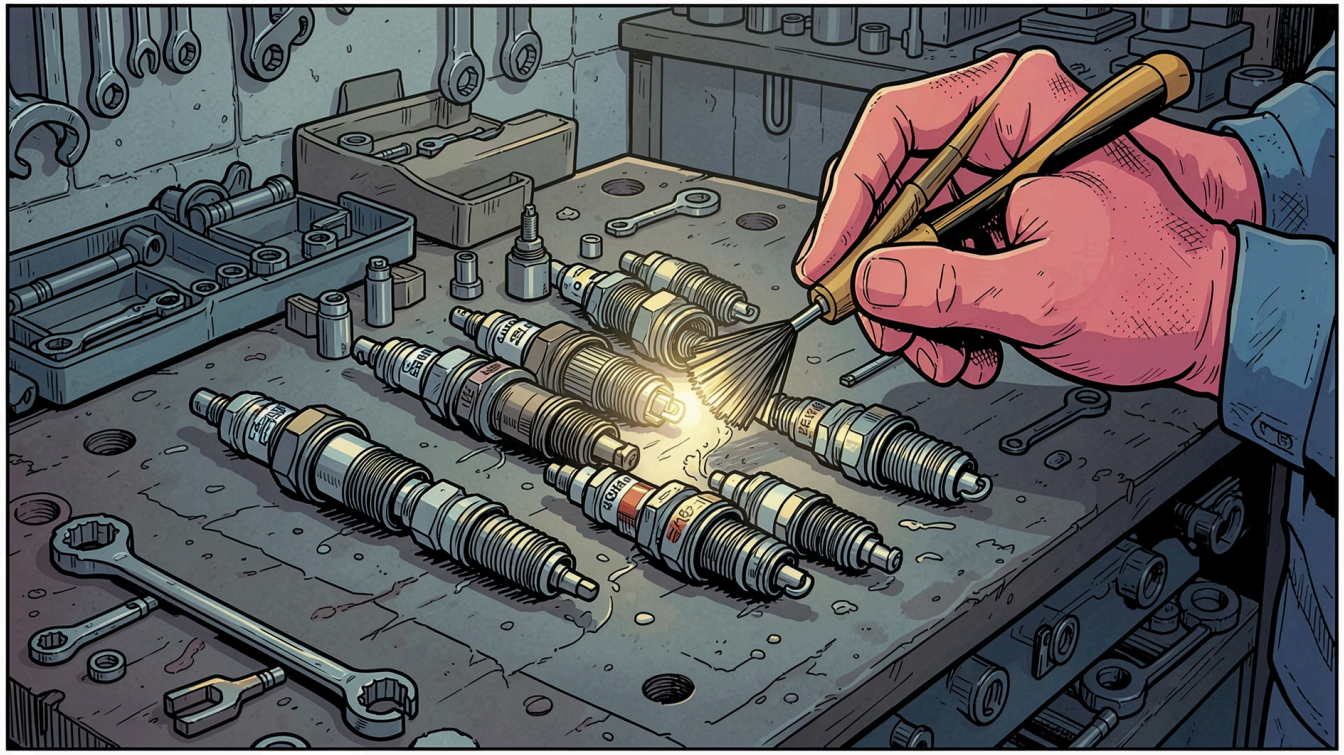
A weak spark on one cylinder suggests a plug or wire fault. System-wide weakness points to the coil or module.



Made with GAMMA

CHAPTER 5

# Spark Plug Service



## Removal

Number each wire before removal. Clear debris from the plug well to prevent contamination of the cylinder.

## Reading the Plug

Deposit colour reveals engine condition: **tan** = healthy, **black oily** = oil burning, **white blistered** = overheating.

## Restoration

Clean electrodes, regap to manufacturer specifications, and reinstall with correct torque to ensure a proper seal.

Made with GAMMA

CHAPTER 6

# The Transition: 1972 High Energy Ignition

1

## Traditional Points

Mechanical contact breakers wore with use, requiring regular adjustment and replacement.

2

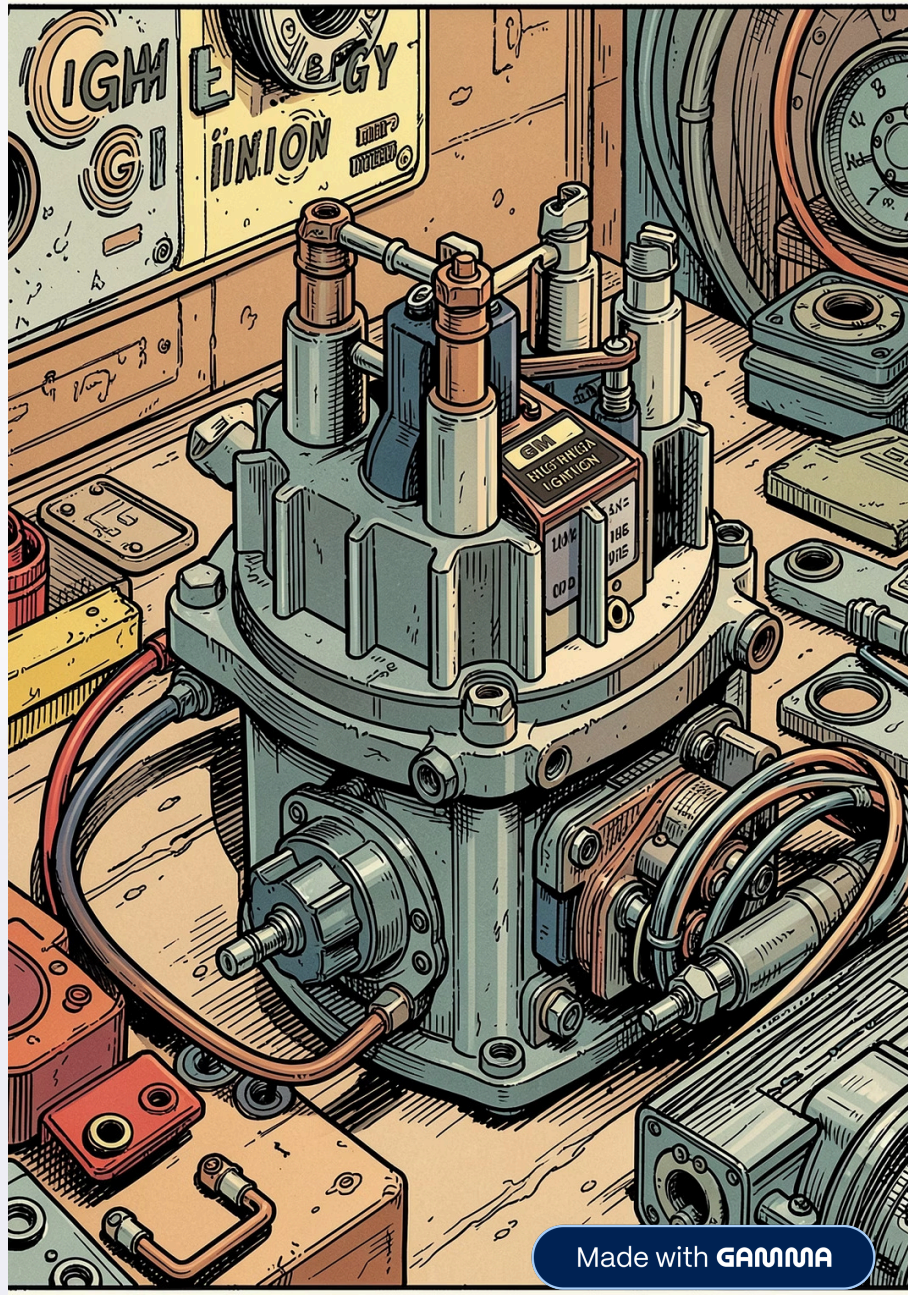
## HEI Introduced

High Energy Ignition replaced points with an electronic module, delivering a hotter, more consistent spark.

3

## Reduced Maintenance

Fewer moving parts meant longer service intervals and dramatically improved reliability.




Made with GAMMA

CHAPTER 7

# Distributorless Revolution: 1985

## Eliminating Moving Parts

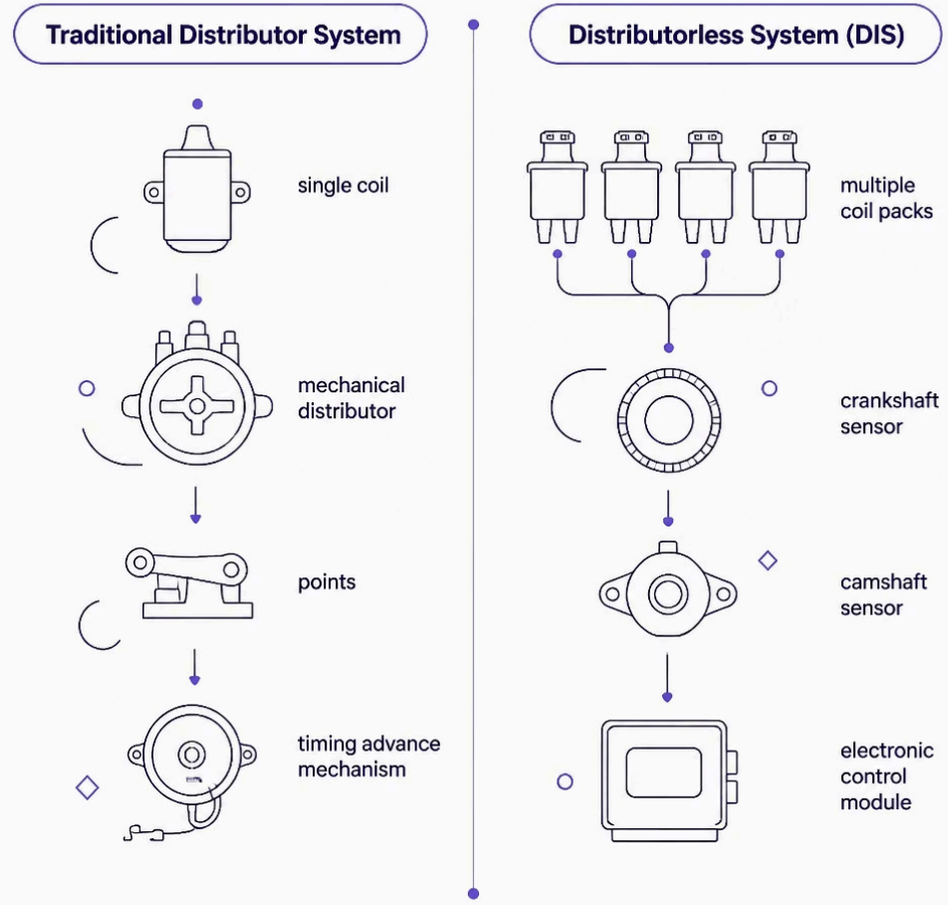
Distributorless Ignition Systems (DIS) removed the distributor entirely, eliminating a major source of mechanical wear and timing drift.

## Coil Packs & Sensors

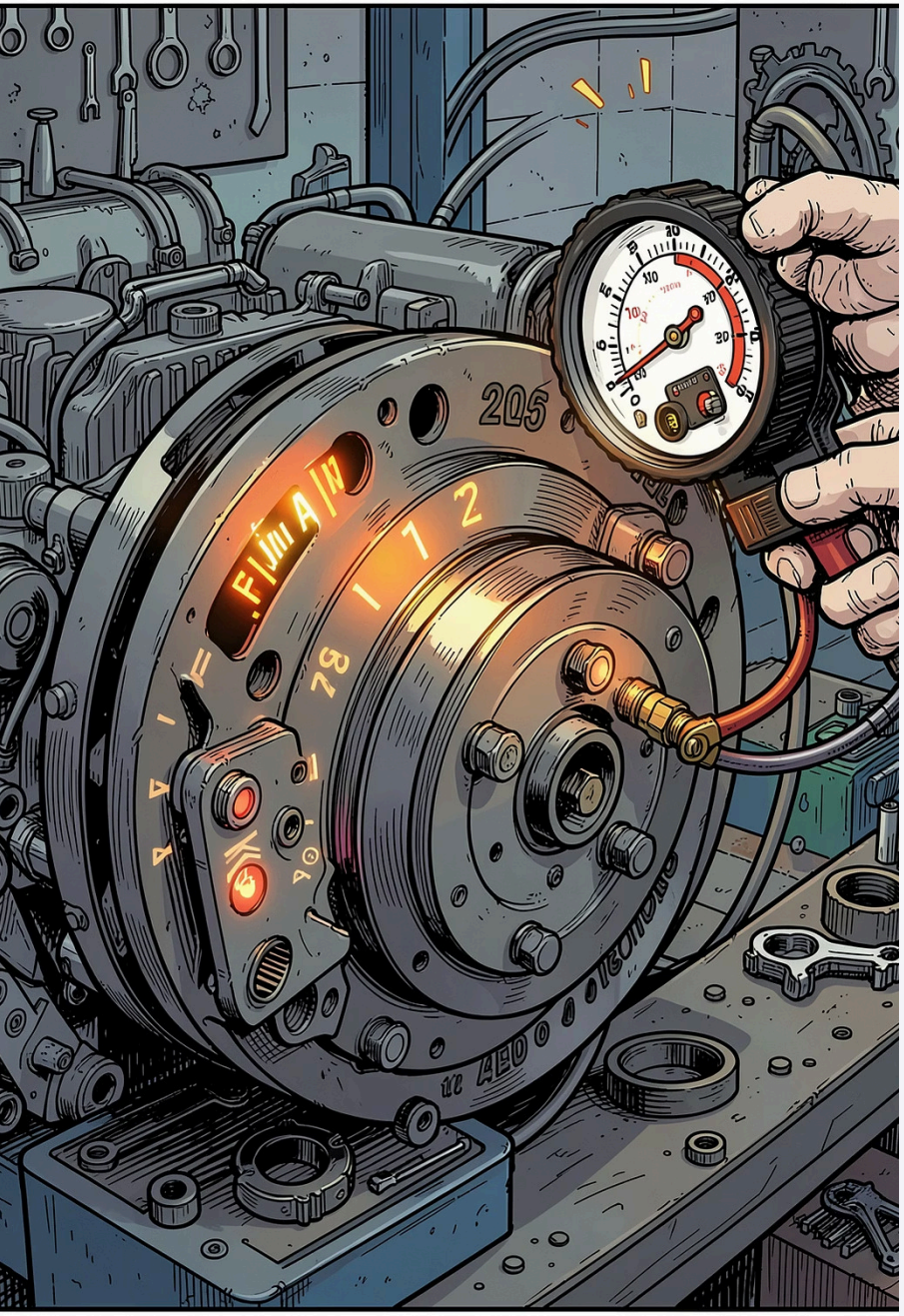
Individual coil packs fired each plug directly, triggered by **crankshaft and camshaft position sensors** feeding data to the ignition module.

## Performance Gains

Precise electronic timing improved combustion efficiency, reduced emissions, and boosted fuel economy across the rev range.




Made with GAMMA



CHAPTER 8

# Mastering Ignition Timing

1

## Base Timing

Set the spark to fire at the precise moment before top dead centre, as specified by the manufacturer.

2

## The Balancing Act

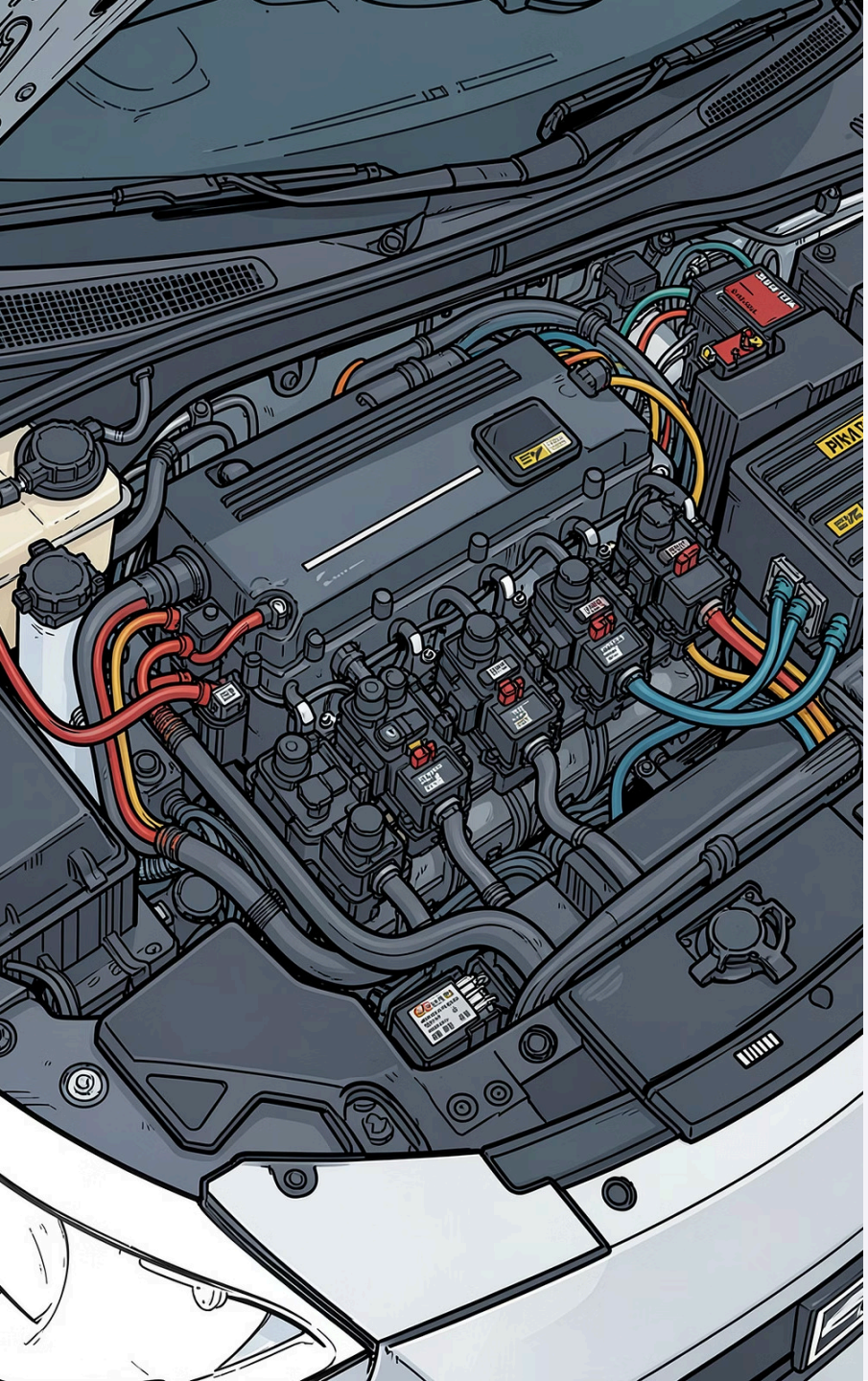
**Advanced timing** increases power; **retarded timing** protects against detonation. Both must be balanced for the operating condition.

3

## Avoiding Engine Damage

Incorrect timing causes "pinging" (pre-ignition), which can destroy pistons and bearings. Use a timing light and listen carefully.

Made with GAMMA



CHAPTER 9

# The Modern Standard

### Digital Twin Spark & Direct Ignition

Modern engines use individual coil-on-plug systems with twin-spark technology for complete, efficient combustion.

### ECU Maintenance

Electronic Control Units manage timing in real time. Keep software updated and sensors clean for optimal performance.

### The Golden Rule

Across every era, **consistent testing protocols** remain the key to diagnosing faults and maintaining peak efficiency.

From Kettering's points to today's direct ignition — the principle remains unchanged: deliver the right spark, at the right moment, every time.

Made with GAMMA